

Bakersfield, California
Airport Traffic Control Tower (ATCT)

A/C Replacement Project

DIVISION 1
GENERAL REQUIREMENTS

1-1.0 SUMMARY OF WORK: Furnish all labor, equipment and materials to accomplish the following:

1. AH-1/CU-1: Replace existing split system air handling unit and condensing unit, including disconnect switches, refrigerant piping, ductwork transitions and flex connections, condensate drain, thermostat and controls; make electrical connections.
2. AH-2/CU-2: Replace existing split system air handling unit and condensing unit, including disconnect switches, refrigerant piping, ductwork transitions and flex connections, condensate drain, thermostat and controls; make electrical connections.
3. AH-3/CU-3 (AH-3/HP-3): Replace existing split system air handling unit and condensing unit with new air handling and heat pump unit, including disconnect switches, refrigerant piping, ductwork transitions and flex connections, condensate drain, thermostat and controls; make electrical connections.
4. AH-4/CU-4: Replace existing split system air handling unit and condensing unit, including disconnect switches, refrigerant piping, ductwork transitions and flex connections, condensate drain, thermostat and controls; make electrical connections.
5. AH-5/CU-5: Replace existing split system air handling unit and condensing unit, including disconnect switches, refrigerant piping, ductwork transitions and flex connections, condensate drain; make electrical and control connections; upgrade and modify existing controls, as needed, to accommodate new equipment.
6. AH-6/CU-6: Replace existing split system air handling unit and condensing unit, including disconnect switches, refrigerant piping, ductwork transitions and flex connections, condensate drain; make electrical and control connections; upgrade and modify existing controls, as needed, to accommodate new equipment.
7. AH-7/HP-7A/HP-7B: Replace existing split system air handling unit and heat pump units, including disconnect switches, refrigerant piping, ductwork

transitions and flex connections, condensate drain; make electrical and control connections; upgrade and modify existing controls, as needed, to accommodate new equipment.

8. AH-410/CU-410 (*AH-410/HP-410*): Replace existing split system air handling unit and heat pump unit, including disconnect switches, refrigerant piping, ductwork transitions and flex connections, condensate drain, thermostat and controls; make electrical and controls connections.
9. AC-210 (*AH-210/CU-210; this is a backup to AH-2/CU-2*): Replace existing indoor packaged air conditioning unit with new split system air handling unit and condensing unit, including new disconnect switches, refrigerant piping, ductwork transitions and flex connects, condensate drain; provide replacement breakers in existing panels with new wiring and conduit to serve new condensing unit and air handling unit; install overtemp thermostat in existing control panel to switch lead operation from AC-2/CU-2 to AC-210/CU-210 if room temp exceeds 80°F.
10. Provide three temporary portable heat pump units (14,000 BTUH capacity) for heating and cooling during A/C replacement work.

See drawings for additional detailed information. The air conditioning systems specified herein or shown on the drawings shall be complete, functional, and operational in all respects.

1-2.0 PROJECT LOCATION:

Bakersfield Airport Traffic Control Tower (ATCT)
(located on Meadows Field Airport)
1400 Boughton Dr.
Bakersfield, CA 93308

1-3.0 WARRANTY: The Contractor shall warrant all materials, equipment and labor for all work performed under this contract. This warranty shall be for a period of one calendar year beginning upon the date of contract acceptance inspection (CAI). The warranty shall be unconditional and the Contractor shall furnish all labor and materials required to repair or replace defective or failed portions of the contract work. Warranty repair work shall be performed in the same manner as new work in accordance with the technical requirements of this specification. Any warranty repairs shall be completed by the Contractor within a maximum of 24 hours after notification by the Government for any failure which causes a mechanical system to be inoperative. Other failures or defects which have no operational impact to the facility shall be corrected within a maximum of 15 calendar days after notification by the Government. The specific items of work performed under warranty shall then themselves be unconditionally warranted

for a period of one calendar year beginning upon the date of completion of the repair work.

In addition to the above unconditional warranty, the refrigerant compressors shall be guaranteed by the air conditioning unit manufacturer for an additional four years beginning one calendar year after the date of CAI. This additional manufacturer's four year guarantee shall include furnishing new replacement compressors, but does not include labor and materials required to replace the compressors. The Contractor shall furnish to the resident engineer (R.E. or RE) the manufacturer's certificate of this warranty stating the beginning and ending dates of the period of coverage. Also, guarantee that each piece of apparatus shall have a capacity or performance of not less than that specified or indicated on drawings, when the apparatus is operating under specified design conditions.

1-4.0 SUBMITTALS: Within seven (7) calendar days after the date of contract award, the Contractor shall submit to the Contracting Officer a list of all materials and equipment to be used under this contract. This list shall include a brief description of the materials or equipment, the name of the manufacturer, and the model or type number.

The use of brand name with, or without, an or approved equal statement following the purchase description in this specification or on the project drawings is intended to promote competition by encouraging the offering of products that are equal in all material respects to the brand name products cited in such descriptions. The reference by brand name does not indicate a preference for the products mentioned but identifies a product known to furnish the quality and characteristics that meet the requirements of this specification. All characteristics of a specified brand name product which are essential to the Government are described in this specification or on the project drawings. The Contractor shall obtain product literature from the manufacturer of the specified brand name product to determine its general quality and functional characteristics and shall use that information in making any desired substitutions.

Where the Contractor elects to use the manufacturer and model number specified herein, no further technical information or shop drawings need to be submitted. Where the Contractor desires to utilize the products of another manufacturer or where no make or model is specified, a complete set of shop drawings and descriptive literature shall be submitted. Contractor shall submit three (3) copies of descriptive literature, shop drawings, and/or samples to the RE for approval for any item he wishes to submit as equal to the brand name(s) as specified.

Information shall be submitted within seven (7) calendar days after the date of contract award and shall include, but not be limited to the following, where applicable:

- (1) Air conditioning equipment including air handling units, condensing units, etc.
- (2) Ductwork and accessories
- (3) Insulation

- (4) Controls
- (5) Electrical equipment
- (6) Piping and accessories

Shop drawings shall include manufacturer's catalog data and certified capacity data. Information submitted shall be complete to enable the item to be evaluated from an engineering viewpoint and shall be sufficient to show compliance with this specification.

The project drawings are designed for the particular manufacturer and model specified. However, where required to show specific details of equipment interface, attachment, support, wiring, etc., the Contractor shall provide any additional shop drawings or descriptive literature for any equipment, including that specified, as required by the Contracting Officer or the RE.

The Contractor shall carefully select equipment and materials, furnish shop drawings and other documentation required above, place and confirm orders for equipment and materials, and schedule all delivery dates in a manner which conforms with the performance time and advance acquisition time allotted by this contract.

Notice-To-Proceed with on-site work will not be granted until the Contractor certifies to the Contracting Officer that all required materials and equipment, as approved by the Government, are in his possession and ready for installation.

1-5.0 PERFORMANCE TIME: The Contractor shall be required to commence work under this contract within one day after the date of Notice-To-Proceed, prosecute the work diligently and complete the entire work ready for use no later than 30 calendar days after the date of Notice-To-Proceed.

Prior to the effective date of the Notice-To-Proceed with on-site work, a maximum of 30 calendar days lead time after the date of Contract Award will be allowed to obtain the required materials and equipment. All shop drawing submissions shall also be accomplished during this lead time. The time required from submission of shop drawings to approval by the Government will not be included in the above specified lead time. Notice-To-Proceed with on-site work will not be granted until the Contractor certifies to the Contracting Officer that all required materials and equipment, as approved by the Government, are in his possession and ready for installation. The Contracting Officer will coordinate the Notice-To-Proceed date with the Contractor to ensure his ability to commence work upon that date.

1-6.0 WORK SCHEDULE: All work shall be scheduled and performed between the hours of 7:00 AM to 5:00 PM except when prior approval has been obtained from the Resident Engineer and unless otherwise noted in specifications and drawings; note that ATCT Cab A/C shutdown must be scheduled between the hours of 11:00PM to 6:00AM.

Alternate work schedules such as 10 hours per day for 4 days per week are acceptable. Total work time per week shall not exceed 40 hours. All work schedules proposing more than 8 hours of work per day shall be approved in advance by the R.E. No work shall be scheduled or performed on Saturdays, Sundays or federal holidays.

1-7.0 AVAILABILITY OF UTILITIES:

Water is available for the Contractor's use.

Electricity is available for the Contractor's use.

Sanitary facilities are available for the Contractor's use at Government expense.

Sanitary facilities shall be kept cleaned and sanitary at all times.

Public telephone service is not available for the Contractor's use at the project location.

It is suggested that the Contractor furnish his personnel with electronic paging equipment, cellular telephones or make other arrangements to maintain communications. The Government will not be responsible for receiving telephone calls, taking messages or contacting Contractor personnel to deliver messages.

Trash removal shall be the Contractor's responsibility. Furnish appropriate waste receptacles and service to pickup and transport all waste material to an approved commercial dump or waste processing facility.

1-8.0 PERFORMANCE OF WORK BY CONTRACTOR: The Contractor shall accomplish a minimum of 25% of the contract work by personnel employed by his own organization.

1-9.0 PRECONSTRUCTION CONFERENCE: A preconstruction conference will be held at the project site between the representatives of the Government and the Contractor prior to the start of work.

1-10.0 SECURITY REQUIREMENTS: The Contractor shall comply with all security requirements of the facility and of the Bakersfield Airport Authority.

1-11.0 GOVERNMENT FURNISHED MATERIALS (GFM): None

1-12.0 LIST OF PROJECT DRAWINGS:

1. BFL-D-ATCT-M001, Rev. 0, 9-15-2009
Airport Traffic Control Tower
Air Conditioning Replacement Project
Equipment Schedules
2. BFL-D-ATCT-M002, Rev. 0, 9-15-2009
Airport Traffic Control Tower
Air Conditioning Replacement Project
First Floor Mechanical Plan & General Notes
3. BFL-D-ATCT-M003, Rev. 0, 9-15-2009
Airport Traffic Control Tower
Air Conditioning Replacement Project
Second and Third Floor Mechanical Plan
4. BFL-D-ATCT-M004, Rev. 0, 9-15-2009
Airport Traffic Control Tower
Air Conditioning Replacement Project
Fourth and Fifth Floor Mechanical Plan
5. BFL-D-ATCT-M005, Rev. 0, 9-15-2009
Airport Traffic Control Tower
Air Conditioning Replacement Project
Cab Floor Mechanical Plan
6. BFL-D-ATCT-M006, Rev. 0, 9-15-2009
Airport Traffic Control Tower
Air Conditioning Replacement Project
Piping Details
7. BFL-D-ATCT-M007, Rev. 0, 9-15-2009
Airport Traffic Control Tower
Air Conditioning Replacement Project
Sections
8. WP-D-601-40104-10-E4, Rev. A, 1-30-1996
ATCT
Cab Air Conditioning Controls
9. WP-D-601-40104-10-E5, Rev. A, 1-30-1996
ATCT
AH Control Diagram
TRACON Electronic Equipment Room

10. WP-D-601-40104-10-E6, Rev. B, 9-15-2009
ATCT
Typical AH Unit Control Diagram
11. BFL-D-ATCT-D001 ('1st Floor New HVAC Plan')
Rev. B, 9-15-2009,
A/C Replacement Project – Demolition Plan
12. BFL-D-ATCT-D002 ('2nd and 3rd Floor New HVAC Plans')
Rev. B, 9-15-2009,
A/C Replacement Project – Demolition Plan
13. BFL-D-ATCT-D003 ('4th and 5th Floor New HVAC Plans')
Rev. B, 9-15-2009,
A/C Replacement Project – Demolition Plan
14. BFL-D-ATCT-D004 ('Cab Level Mechanical Plan and Equipment Schedule')
Rev. B, 9-15-2009,
A/C Replacement Project – Demolition Plan

Bakersfield, California
Airport Traffic Control Tower (ATCT)

A/C Replacement Project

DIVISION 2
AIR CONDITIONING

2-1.0 SCOPE: The Contractor shall furnish and install air conditioning units, fan-coil units, condensing units, heat pump units, ductwork and accessories, piping, controls, and electrical work as specified herein. The air conditioning systems specified herein or shown on the drawings shall be complete, functional, and operational in all respects.

2-2.0 CODES AND STANDARDS: All labor and material shall be in strict conformance with the rules and regulations of the Air Conditioning and Refrigeration Institute (ARI), National Fire Protection Association (NFPA), American Society for Testing and Materials (ASTM), and American Society of Mechanical Engineers (ASME), where such standards have been established for the particular item of equipment used.

All equipment and materials shall be installed in accordance with the manufacturer's instructions. A copy of the manufacturer's installation instructions shall be maintained on site and made available to the Resident Engineer (R.E.) before any equipment is installed or any work with that material begins.

2-3.0 APPLICABLE DOCUMENTS: The following standard publications, of the issues currently in force, form a part of this specification. The Contractor shall perform all work not included in this specification in accordance with these publications:

International Conference of Building Officials	Uniform Mechanical Code Latest Edition
International Conference of Building Officials	Uniform Plumbing Code Latest Edition
Sheet Metal and Air Conditioning Contractors National Association (SMACNA)	HVAC Duct Construction Standards, Metal and Flexible, 2005
National Fire Protection Association	National Electrical Code, Latest Edition
Federal Aviation Administration	FAA Standard 019e, Lightning and Surge Protection, Grounding, Bonding

and Shielding Requirements for
Facilities and Electronic Equipment

Federal Aviation Administration

FAA-C-1217f,
Electrical Work, Interior

(Manufacturer of Installed
Equipment) Applicable Edition
For Model Number

Equipment Installation Instructions,
Specified or Approved

2-4.0 AIR DISTRIBUTION: Items not shown in detail nor covered by detailed specifications shall be as set forth in the SMACNA HVAC Duct Construction Standards, Metal and Flexible. The project drawings show the general location, orientation, and alignment of duct, registers, grilles, and other devices. The Contractor shall be responsible for field verification of the system layout and shall determine the exact location of all components to avoid interference with building structure, light fixtures, ceiling grid, other mechanical systems, etc. Any duct offsets, transitions, adapters, or special supports required for installation shall be furnished by the Contractor at no additional expense to the Government.

2-4.1 Sheet Metal Ductwork: Sheet metal ductwork shall be constructed of galvanized steel sheets. Ducts shall conform to the dimensions indicated and shall be straight and smooth on the inside, with joints neatly finished. Duct transverse joints shall be by a bolted preformed angle with integral gasket and sealant configured to give maximum rigidity to the joint with an airtight seal. Transverse joints shall be Ductmate 25 or 35, or approved equal, with the type and installation in accordance with the manufacturer's instructions. Longitudinal seams shall be "Pittsburgh lock" construction. All edges and slips shall be hammered down to leave a smooth interior duct finish. All seams and joints in duct system, other than transverse joints with integral seal, and all joints where ducts pass through building walls shall be sealed to withstand a pressure of plus or minus 4" of water gage and finished to a smooth surface and made completely airtight. Apply sealant in accordance with manufacturer's recommendations. Sealant shall be Rectorseal Air-Lock 181, or approved equal. All sealants shall be water based; Petroleum based sealants will not be permitted due to their inherent hazardous vapors. Sealant on exposed duct shall be applied in a manner which results in a smooth surface free of runs, cracks, holes and splatter on adjacent surfaces. Following curing, the adhesive shall be painted with two coats of exterior latex enamel of a color to match the duct.

All new ducts and modified portions of existing ducts shall be anchored securely to the framing in the building. Attachments and hangers shall be selected and installed to safely support the load, to prevent sagging of the duct, and to restrain horizontal movement of the duct. Ducts shall be so constructed and installed as to be completely free from vibration under all conditions of operation. Supports shall be attached only to structural framing members or to concrete surfaces with expansion anchors. Where

supports are required between structural framing members, RE approved intermediate metal framing shall be provided.

2-4.2 Duct Liner:

2-4.2.1 Acoustical Duct Lining: All supply and return duct shall be provided with acoustical liner. Acoustical duct lining shall be fibrous glass, flexible type, with vapor barrier designed exclusively for lining duct. For service in low-velocity duct systems, the air-side surface of the liner shall be capable of withstanding air velocity of 5,000 feet per minute without delamination or erosion. The surface coating shall be formulated with an anti-microbial agent so it will not support the growth of fungus or bacteria. The material thickness shall be either one (1) inch or as shown on the project drawings, whichever is greater. Thermal conductivity shall be no greater than .25 BTU-Inch per square foot per °F per hour at 75 °F. Liner Noise Reduction Coefficient (NRC) shall be .70 minimum for 1" thick and 1.00 minimum for 2" thick material. NRC shall be calculated in accordance with ASTM standard E795. Air friction correction factor shall not exceed 1.05 at 1,000 feet per minute air velocity. The acoustical liner shall conform to the fire hazard classification requirements of the National Fire Protection Association.

The lining shall be applied in cut-to-size pieces attached to the interior of the duct with fire resistant adhesive. Top and bottom pieces shall lap the side pieces and, in addition, shall be secured with welded pins, adhered clips, metal, nylon or high impact plastic, and speed washers or welding cuphead pins on maximum 12 inch centers. Lining shall not be folded at corners or treated in any manner that reduces thickness and impairs insulating properties of material. Liner shall be neatly butted without gaps at transverse joints and shall be coated with adhesive at such joints. All exposed edges of liner shall be coated with lagging adhesive to prevent delamination. Lagging adhesive shall be Foster Sealfas 30-36, or approved equal. Duct liner shall be Johns-Manville "Permacote Linacoustic Standard", or approved equal.

2-4.2.2 Rigid Liner Board: All supply and return duct shall be provided with interior liner insulation. Duct liner shall be fibrous glass, rigid type, with vapor barrier designed exclusively for lining duct. For service in low-velocity duct systems, the air-side surface of the liner shall be capable of withstanding air velocity of 5,000 feet per minute without delamination or erosion. The surface coating shall be formulated with an anti-microbial agent so it will not support the growth of fungus or bacteria. The material thickness shall be 1 inch or as shown on the project drawings, whichever is greater. Thermal conductivity shall be no greater than .23 BTU-Inch per square foot per °F per hour at 75 °F. Air friction correction factor shall not exceed 1.05 at 1,000 feet per minute air velocity. The acoustical liner shall conform to the fire hazard classification requirements of the National Fire Protection Association.

The liner board shall be applied to all interior surfaces of the entire duct system. The smooth, black surface shall face the airstream. Cut all liner pieces to assure tight overlapped corner joints with no metal exposed to the airstream. The top pieces shall be supported by the side pieces. Adhere liner to the duct with full coverage of adhesive

approved by the liner manufacturer. Coat all leading edges and transfer joints with an edge treatment approved by the liner manufacturer. The liner board shall also be secured to the duct with mechanical fasteners. Fasteners shall be the "adhered pin, press-on-head" type. Secure the fasteners to the metal duct with approved adhesive; do not spot weld the pins due to the damage it causes to the duct galvanizing. Space the fasteners per the liner manufacturer's schedule for 0-2500 fpm velocity. Liner board shall be Johns-Manville Permacote Linacoustic R-300, or equal.

2-4.3 Turning Vanes: Turning vanes shall be provided in all air duct square and rectangular elbows. Vanes shall be of the small, curved, double-walled type for uniform air distribution and change of direction with minimum turbulence and pressure loss. Air shall leave turning vanes parallel to sidewalls of the duct. Turning vanes shall be constructed per SMACNA Figure 2-3.

2-4.4 Flexible Duct Connection: Where sheet metal connections are made to equipment, a flexible connection of 22-ounce per square yard oil and acid resistant, noncombustible material approximately 3 inches in width shall be installed. Flexible connections shall be securely fastened and locked to 24 gauge metal collars using normal duct construction methods. Flexible duct connections shall be installed to provide not less than 2 inch clear space between metal parts being connected and shall be free of tension permitting movement at either side without transmitting movement to the other side. Flexible connectors shall be Duro-Dyne "Metal-Fab" with "Excelon" fabric, or approved equal. All flexible connectors installed on equipment located outdoors shall be weather protected with a 22 gage sheetmetal cover secured to the equipment cabinet and configured to shade the connector fabric on the top and both sides of the duct. Cover shall not restrict the duct or equipment movement in any direction.

2-4.6 Volume Dampers: Manual volume dampers for rectangular ducts shall be multilouver type, opposed acting, with interlocking blades having a maximum blade width of 6 inches. Dampers shall be constructed of 16 gauge galvanized steel, and be mounted in suitable band or angle iron frames, strongly braced for rigidity. Multilouver dampers shall be Pottorff Series 20, or approved equal. Provide optional 1/2" round drive axle. Provide Duro-Dyne Model KL-7R damper quadrant, or approved equal.

Manual volume dampers for round ducts shall be single blade type of 16 gauge galvanized steel. Size blade to permit a maximum of 5% of design balance air flow when blade is in closed position. Provide Model KS-145L bearing/ regulator kit as manufactured by Duro-Dyne, or approved equal.

2-4.7 Duct Support: Ducts concealed from view, such as in attics above suspended ceilings, shall be supported from overhead by not less than 1 inch by 22 gauge galvanized strap steel hangers. Hangers shall be anchored on each side of the duct with one screw on bottom and at least one on each side. Hangers shall be spaced not over 8 feet on center and at each change of direction. Size and install hangers per

SMACNA Section IV. Anchor ducts securely to prevent vibration under all conditions of operation.

Ducts exposed to view shall be supported from overhead by trapeze hangers consisting of two steel rods supporting a steel channel (Unistrut P-2000, or equal) which the duct shall rest upon. Hangers shall be spaced not over 8 feet on center and at each change of direction. Size and install hangers per SMACNA Section IV. Anchor ducts securely to prevent vibration under all conditions of operation.

Ducts supported from walls or from floor or other structures below shall be by galvanized steel angle welded or bolted to ensure a rigid structure. The Contractor shall be responsible for selecting the proper size of steel members to support the required duct weight for the specified height above the supporting surface and to withstand any wind or seismic loading specified in this contract.

2-4.8 Air Distribution Devices:

2-4.8.1 Steel Grilles/Registers: Air grilles shall be constructed of 20 gage steel frame with fixed straight horizontal louvers of 3/4" spacing and 45° angle. Finish shall be baked white enamel. Frame size shall be as required by the project drawings. Grilles shall be Anemostat model S3HD, or approved equal.

2-4.9 Gravity Backdraft Dampers: Gravity backdraft dampers shall be of the size shown on the drawings. Gravity backdraft dampers shall be of low leakage type and designed for operation in the vertical position for horizontal air flow. Blades shall be 16 gage aluminum. Frames shall be 3-1/2 inches by 1 inch by 16 gage hot-dip galvanized steel hat channel. Bearings shall be pressed fit flanged ball. Dampers shall have blade-to-blade linkage, consisting of plated steel blade clevis brackets, brass barrels, and 5/16 inch diameter hot-dip galvanized steel rod. Damper blades shall be equipped with dual durometer vinyl seals. Jambs shall have ethylene propylene terpolymer (EPT) sponge seals. Pressure drop shall not exceed .28 inch water gage at a face velocity of 1000 fpm. Leakage shall not exceed 26 cfm per square feet at .5 inch water gage differential pressure and 70 degrees F. Gravity backdraft dampers shall be American Warming and Ventilating, Ruskin or approved equal.

2-4.10 Access Doors: Access doors shall be installed in the ductwork at the location of all backdraft and motorized control dampers and at any other locations designated on the project drawings. Install access doors on the downstream side of backdraft dampers and on the downstream side of motorized control dampers unless approved by the R.E. to be installed elsewhere due to obstructions.

Access doors shall be constructed of 24 gage galvanized steel frame and 24 gage galvanized steel double skin door with 1" insulation inside. Furnish continuous piano hinge and camlock latches. Also, furnish a round transparent plexiglass inspection window on access doors serving gravity backdraft dampers only. Access doors shall be Phillips-Aire model FSA-100, or approved equal.

2-5.0 AIR CONDITIONING EQUIPMENT: Equipment make and model and all performance data shall be in accordance with the data table on the project drawings. The minimum/maximum performance data specified shall not be below the minimum nor above the maximum by more than 5% of the specified value.

2-5.0.1 Split System Air Conditioner: The system major components including heat pump or condensing unit, refrigeration flow controls, air handling unit, and evaporator coil shall be all sized, selected, and assembled by one equipment manufacturer. That manufacturer shall provide certified performance data for the total system to show compliance with the data table on the project drawings.

2-6.0 PIPING: The Contractor shall check all dimensions and shall establish all lines and levels affecting piping and other work specified herein. Such lines, grades, and levels shall be checked with the work of other trades to assure proper clearance of piping and equipment. The Contractor shall be held responsible for correctness of lines, grades, and levels so established and shall provide all fittings and accessories required to satisfy field conditions affecting pipe installation.

Pipe shall be cut accurately to measurements established at the site by the Contractor and shall be worked into place without springing or forcing. Piping shall be run parallel with the lines of the building unless otherwise indicated. A clearance of not less than one inch shall be kept between pipe, or finished covering, and other work or the different piping services. Branch connections and changes in pipe size shall be made with standard pipe fittings. Change in direction shall be made with fittings.

Allowance shall be made throughout for expansion and contraction of piping. Flexibility shall be provided by use of one or more turns to allow piping to spring without straining.

Pipes in exposed locations shall be grouped and be neatly aligned. Vertical pipes shall be accurately plumbed. Horizontal pipes shall be installed parallel to structural members and level or at a uniform slope when a pitch is required. Groups of vertical pipes shall be aligned parallel to a wall whenever practicable, otherwise, they shall be aligned 90 degrees to a wall. Groups of horizontal pipes shall be aligned either horizontally or vertically.

2-6.1 Pipe Hangers and Supports: All piping shall be supported, anchored, and guided in a manner such that expansion and contraction will take place in the direction desired and vibration and undue strain on equipment will be prevented. Hangers shall have means of vertical adjustment after piping is in place. Supports on flat surfaces shall be with "Unistrut" P-2558 pipe strap bolted to P-1000 channel, or approved equal. Location of hangers shall be coordinated with the structural work to assure that structural members will support the load under operating conditions.

Hangers and clamps applied to bare copper shall be electrolytically coated or padded with felt. Hangers applied to piping specified to be insulated shall be sized for the outside diameter of the insulation. Furnish a rigid non-compressible urethane or

calcium silicate block (Dow Corning Trymer, or approved equal) insulation insert of 1" minimum thickness or of equal thickness to the adjoining insulation, whichever is greater, and 12" maximum length at each hanger. Spacing between supports shall be not more than 6 feet for tubing up to 1-1/2 inches in diameter and 10 feet for tubing 2 inches and larger. Also, support at each change of direction. Where concentrated loads, such as valves, flanges, and accessories occur, the above spacing does not apply and each location shall be supported.

Where necessary to maintain support spacing, structural members shall be bridged to suit hanger locations.

2-6.2 Condensate Drain Pipe Joint Fabrication: Condensate drain piping shall be fabricated from Type M, hard drawn copper tubing and standard weight wrought copper fittings. Swaged joints shall not be used. Tubing cuts shall be made square, using a sharp wheel cutter or fine tooth hacksaw, reamed after cutting to remove burrs. Soldered joints shall be made in the following manner: (1) Cut tube end square; ream, de-burr and size. (2) Use sand cloth or steel wire brush to clean tube and cup to a bright metal finish. (3) Apply solder flux to outside of tube and inside of cup of fitting carefully so that surfaces to be joined are completely covered. Select flux in accordance with solder manufacturer's instructions. Use flux sparingly. (4) Apply flame to the fitting to heat tube and solder cup of fitting until solder melts when placed at joint of tube and fitting. (5) Remove flame and feed solder into the joint at one or two points until a ring of solder appears at the end of the fitting (The correct amount of solder is approximately equal to the diameter of the fitting...5/8" solder for 5/8" fitting, etc.). (6) Remove excess solder with a small brush or wiping cloth while plastic.

2-6.3 Refrigeration Systems: Refrigerant piping indicated is schematic only. Provide the equipment manufacturer's "Installation Manual" including required piping schematic. Size piping and design the actual piping layout, including oil traps, double risers, specialties, slopes of runs, required controls, and pipe and tube sizes, to ensure proper operation and compliance with warranties of connected equipment.

2-6.3.1 Moisture/Liquid Indicators and Sight Glass: 500-psig maximum working pressure and 200 deg F operating temperature; all-brass body with replaceable, polished, optical viewing window with color-coded moisture indicator; with solder-end connections. Emerson "HMI" Moisture Liquid Indicator or approved equal.

2-6.3.2 Refrigerant Piping: Refrigerant piping shall be fabricated from Type L, ACR quality hard drawn copper tubing and standard weight wrought copper fittings. Swaged joints shall not be used. Ells shall be long radius type. Tubing cuts shall be made square, using a sharp wheel cutter or fine tooth hacksaw, reamed after cutting to remove burrs. Refrigerant piping having joints to be high temperature brazed shall be blown out with dry nitrogen gas and a small amount of this gas shall be allowed to flow during and after brazing. The gas shall be allowed to flow until the temperature of the tubing is below the oxidation point. Extreme care shall be exercised to prevent overheating and subsequent pitting, burning or annealing of the base pipe material.

Any joints which show pitting, burning, or other evidence of overheating will be rejected by the Government and shall be replaced by the Contractor.

Joints shall be made with high strength, silver/copper brazing alloy. Brazing alloy shall be composed of 15% silver/80% copper with a liquidus temperature of 1480°F and a tensile strength of 85,000 psi minimum. Brazing alloy shall be J.W. Harris "Stay-Silv 15", or approved equal.

Where high brazing temperature is not acceptable such as at valves and other speciality fittings with non-removable parts and where approved by the R.E., join the piping utilizing silver-tin alloy solder with a liquidus temperature of no greater than 535°F to prevent damage to temperature sensitive parts. Tensile strength shall be 15,000 psi minimum. Solder shall be used only for piping operating at a temperature below 150°F and shall not be used for any hot gas lines. Solder shall be J.W. Harris "Stay-Brite 8", or approved equal. Following soldering, clean all acid, flux, carbon or other contaminations from the pipe joint.

2-6.3.3 Refrigerant Pipe High Pressure Leak Testing: After the installation of refrigerant piping fabricated and installed by the Contractor is complete, the entire refrigerant circuit shall be tested by the Contractor in the Resident Engineer's presence to prove it is absolutely tight. (This requirement does not apply to package type air conditioners and other self contained systems which were factory tested by the manufacturer and whose refrigerant circuits were not opened or otherwise modified by the Contractor's activities). All expansion and compressor valves shall be open to pressure. The test pressure shall be achieved using dry nitrogen to 350 psi, or manufacturer's recommendations, whichever is higher; and held for a period of 2 hours. If, during that time, the test pressure drops by more than 5 psi, the Contractor shall visually test the entire system for leaks including the compressor, coils, refrigerant connections to the controls, valves, and piping joints using liquid soap application (or other product intended for visual leak identification) and visual inspection for bubbles created by leaks. If leaks are found, the test pressure shall be relieved, the leak repaired, and the test repeated. To repair a leak, the joint shall be taken apart, thoroughly cleaned and remade in the same manner as new work, with nitrogen flowing in the line whenever heat is applied.

2-6.3.4 Evacuation: After the refrigerant system has been high pressure leak tested and found to be tight, the test pressure shall be relieved. Evacuation of the system shall be performed during a period when the ambient air around all components is 60°F or above during at least some part of the evacuation period, unless otherwise approved by the R.E. Evacuation lines shall be copper tubing or high vacuum rubber tubing. Service gauge hoses are not satisfactory. The entire system shall be evacuated to 350 microns of mercury absolute. The system shall be evacuated from both high and low sides together. An electronic instrument capable of reading down to 50 microns shall be used to measure the vacuum. Under no circumstances will a dial type pressure gauge be acceptable for measuring the vacuum. When the desired vacuum has been

obtained (350 microns of Hg. absolute), the pump shall be shut off and the vacuum maintained for at least two hours.

During the two hour period monitor the vacuum pressure every 15 minutes. An initial rise in pressure during the first hour followed by a constant pressure reading not exceeding 1000 microns during the entire second hour is acceptable. Any rise in absolute pressure which continues at a constant rate during the second hour is probably an indication of a leak which must be located and repaired and the above specified high pressure leak testing procedure repeated.

If the absolute pressure is successfully maintained, the vacuum shall then be broken with the proper refrigerant to atmospheric pressure or above and the system charged.

2-6.3.5 Charging: The refrigerant system shall be charged with the specified refrigerant in the amount necessary to clear the sight glass of all bubbles and in accordance with the condensing unit manufacturer's instructions. The amount of charge for each system shall be determined by weight, recorded and included in the refrigeration startup report as specified below.

2-6.3.6 Refrigerant Pipe Medium Pressure Leak Testing: After the system is high pressure leak tested, evacuated and charged as specified above, electronically test for leaks with the compressor(s) and blower(s) off using an electronic refrigerant leak detector. The refrigerant pressure will be at its saturation pressure depending upon the current ambient temperature. The Contractor shall test the entire system for leaks including the compressor, evaporator and condenser coils, refrigerant connections to the controls, valves, and piping joints.

If the above test is successful, start the compressor(s) and blower(s) and repeat the above test on the entire high pressure side of the refrigeration system from the hot gas discharge side of the compressor to the inlet side of the expansion valve or capillary tube and all joints and components in between. The refrigerant pressure will be at its highest saturation or superheated pressure depending upon the current condensing temperature.

If leaks are found, the refrigerant shall be removed and recovered. To repair a leak, the joint shall be taken apart, thoroughly cleaned and remade in the same manner as new work, with nitrogen flowing in the line whenever heat is applied. Following repair, repeat the high pressure testing, evacuation, charging and medium pressure testing sequence specified above.

Document the ambient temperatures and refrigerant pressures measured during the entire testing process and include in the refrigeration startup report as specified below.

2-6.4 Insulation: After tests have been successfully completed and pipe surfaces have been cleaned and dried, insulation shall be installed on pipe, valves and equipment of all new and modified piping systems.

2-6.4.1 Cold Surface Insulation: All refrigerant suction piping, refrigerant liquid line piping on heat pump systems only, condensate drain piping located indoors, and any cold surface subject to condensation shall be insulated. These piping systems, both indoor and outdoor, shall be covered with a flexible, elastomeric thermal insulation with a minimum nominal wall thickness of 3/4" or as shown on the project drawings. Polyethylene or fiberglass insulations are not acceptable. Maximum thermal conductivity shall be .27 BTU-In. per sq. ft.-hour-°F at 75°F mean temperature. Water vapor permeability shall not exceed 0.20 perm-inch per ASTM test procedure E96, procedure B. Water absorption shall not exceed 5% by weight per ASTM test procedure D1056. Flame spread rating shall not exceed 25 and smoke developed rating shall not exceed 50 per ASTM test procedure E84. Insulation shall be capable of preventing condensation on piping with a surface temperature of 35°F in ambient air temperature of 85°F dry bulb, 70% relative humidity. Pipe insulation shall be either unslit for installation as pipe is being assembled or shall have factory longitudinal slit with tape or mastic sealed joint. Field cutting along insulation's length to allow installation over installed pipe shall not be acceptable. Pipe insulation shall be Armacell AP Armaflex or AP Armaflex SS, or equal. Sheet and roll insulation shall be Armacell Armaflex Sheet and Roll, or equal.

2-6.4.2 Insulation Installation: Insulation shall be applied on clean dry surface after all tests are completed and shall be continuous through walls and equipment openings. Insulation on all cold surfaces where vapor barrier jackets are used shall be applied with a continuous, unbroken vapor seal. Piping at supports shall rest upon 1" thick rigid insulation inserts as specified above. Metal shield shall be applied between hangers or supports and the pipe insulation. Shield shall be formed 18 gauge sheet metal to fit rigid insulation insert and shall be in two halves.

Fittings at all locations shall be insulated with miter-cut pipe insulation, with insulation sheet cut to size or with insulation tape of the same material as straight pipe insulation. All butt joints and seams shall be sealed with insulation adhesive. All outdoor insulation shall be covered with 0.016 inch thick aluminum with longitudinal Z-joint and secured with 2-inch side locking straps at butt joints. The aluminum shall be carefully cut and mitered around elbows and fittings for a smooth jacket which totally conceals all insulation. All indoor insulation exposed to view shall be finished with polyvinyl chloride (PVC) insulated fitting covers on all pipe fittings, flanges, valves and pipe terminations. Finish all straight pipe sections with 20 mil thick PVC jacketing. Solvent welding adhesive shall be used to permanently seal all the PVC circumferential lap joints and longitudinal overlap joints in the system. Bands, straps or mechanical clamps for securing the PVC insulation jacketing will not be acceptable. Apply adhesive with strict adherence to the manufacturer's application instructions. Fitting covers and straight pipe jacketing shall be white in color and be ultra violet resistant. They shall also not exceed flame spread 25 and smoke developed 50, as rated by Underwriter's Laboratories. A PVC insulation fitting cover and jacketing brand name known to meet the requirements of this specification is Zeston 2000 PVC, as manufactured by Johns-Manville, Inc.

2-7.0 FILTERS: The air conditioning equipment shall not be operated until filters have been installed. Filters shall be disposable, 2" thick, pleated media type with minimum 11 pleats per lineal foot of filter width, unless otherwise noted. Filter efficiency shall be 25-30% minimum per ASHRAE Standard 52.1 test methods. Filters shall be Eco-Air model E35 or Farr model 30/30, or equal. Filters shall be easily accessible. At the time of final contract acceptance a set of new filters shall be installed and five (5) sets of spare filters shall be provided for each system installed or modified.

2-8.0 CONTROLS: The Contractor shall furnish and install automatic temperature controls as specified herein and as shown on the project drawings. All controls shall be electric or electronic. Control device make and model numbers, or approved equal, shall be as shown on the diagrams on the project drawings.

Upon completion of the contract work, the Contractor shall demonstrate to the RE that all controls are properly calibrated and provide the sequence of operation specified. Provide a minimum of three (3) working days advance notice before this demonstration.

2-8.1 Relays: All control relays shall be plug-in type with blade terminals and a separate matching socket for wire terminations. All relays shall be furnished with a light emitting diode (LED) which illuminates when the relay coil is energized. A relay brand name known to meet the requirements of this specification is Idec type RHXB-UL with type SHXB-05 socket where X = the number of relay poles.

2-9.0 ELECTRICAL: Items not shown in detail or covered by detailed specifications shall be as set forth in the National Electrical Code.

2-9.1 Conduit Fittings: All conduit inside building shall be electric metallic tubing (EMT) with compression ring type fittings. All conduit outside building shall be rigid steel with threaded fittings. Conduit below ground shall be rigid steel with a factory applied plastic coating. All flexible conduit, both inside and outdoors, shall be metallic, liquid tight, and shall be a maximum of 4'.

Conduits shall be installed parallel or at right angles to the building. Conduits shall be securely supported and fastened in place at intervals of not more than 5 feet and at each change of direction. Support from building structural steel, walls, or other R.E. approved structural components. Fasteners shall be conduit hangers or one-hole malleable iron pipe straps with appropriate screws or bolts for the surface material. Conduits shall not be supported from metal roof decking. Suspended ceiling support wires shall not be used for the support of conduits. Changes in direction shall be symmetrical bends or cast-metal fittings. Each conduit entrance to outlet boxes, panel boards, and equipment cabinets shall be fitted with a lock nut and insulated throat connector.

2-9.2 Wire: All wire shall have copper conductors. Size shall be American Wire Gauge (AWG) with size for power circuits as shown on the project drawings. Size for

all control circuits shall be #16 AWG. Power wire #10 AWG and smaller may be stranded or solid; #8 and larger wire, and all control wire, shall be stranded. Insulation shall be type THW or THWN for power wire and type MTW for control wire and shall be color coded as follows:

<u>Single Phase</u>		<u>Three Phase</u>	
<u>120 Volts</u>	<u>208/240 Volts</u>	<u>120/208 or 240 Volts</u>	<u>277/480 Volts</u>
Line-Black	Line 1-Black	Phase A-Black	Phase A-Yellow
Neutral-White	Line 2-Red	Phase B-Red	Phase B-Brown
	Neutral-White	Phase C-Blue	Phase C-Orange
		Neutral-White	Neutral-White

All Circuits:

Ground	Green
Control	Black with numbered adhesive markers on both ends or multiconductor with unique continuous color coded insulation

Power wires #8 and smaller shall have continuous colored insulation. Wires #6 and larger may utilize continuous colored insulation or colored tape. Where conductors are color coded with tape, they shall be half lapped for a minimum length of 3 inches in all junction and pull boxes, accessible raceways, panelboards, outlets, switches and equipment cabinets.

All wire shall be continuous; no splices will be permitted unless specified on the project drawings. Where permitted, splices shall be accomplished with compression type connectors bonded to the wire with a crimping tool and procedure approved by the connector manufacturer. Wires shall not be installed until all conduit and fittings are in place. All wires shall be drawn into conduit simultaneously and with adequate lubricating compound to prevent damage to insulation.

Control wiring installed within control panels shall be neatly routed between the control components and shall run parallel and perpendicular to the sides of the panel. Wires which run diagonally from component to component will not be acceptable. Wiring shall have sufficient slack to prevent tension on the termination connector. Route wires between components in the most direct path possible without overshoots and loopbacks. Wires shall be run in open slot wiring duct (Thomas & Betts model 91XXX, or equal with size as required for application.) or bundles of wires shall be neatly secured with nylon self-locking cable ties. Terminate all control wires with spade type, crimped terminals; Exception: Devices such as relays and terminal blocks which utilize clamp type terminals shall not require crimped terminals on the wire. Wrapping of wires around screw heads shall not be acceptable. All wires exiting the control panel shall terminate on a screw terminal block with each terminal marked the same as on the control schematic on the project drawings.

2-9.3 Grounding: All noncurrent carrying metallic parts of the electrical system shall be grounded with an insulated wire sized and installed in accordance with Article 250 of the National Electrical Code. Ground wire shall be connected to ground bus in each power panel, to ground lug on receptacles, and to enclosure or frame of major electrical devices such as safety switches, motors, motor starters, terminal cabinets, light fixtures, etc. Connection of wire to these devices shall be with a separate machine screw and nut which bonds to a clean, bare metal surface. Self tapping screws are not acceptable for this purpose. Screws which are used for support of the enclosure shall not be used for this purpose.

All ferrous conduit shall be equipped with insulated grounding bushings at each end and the equipment grounding conductor shall be bonded to the bushings with a bonding jumper the same size as the equipment grounding conductor.

2-9.4 Motor Starters: Motor starters shall be of traditional NEMA construction, UL listed and CSA certified, with inspectable and replaceable contacts on all sizes. All starters shall be electrically held and wired to provide low voltage protection and release. Coil and contact kit replacement parts shall be shown on the label or coil of the starter as well as on a separate replacement parts sheet. Coil voltage shall be as shown on the project drawings or, if not shown, shall be the same voltage as the motor line voltage. Coils shall be of an encapsulated construction. All power wiring shall be straight through the starter with incoming power to the top and load wiring at the bottom. All add on auxiliary contacts shall be of a bifurcated construction. Enclosure shall be NEMA 1, 3R or 4, as specified on the project drawings. If not specified on the project drawings, furnish the appropriate enclosure for the application based upon NEMA guidelines.

Overload protection is to be provided by a solid state overload relay that is close coupled to the contactor. The overload relay must be self-powered requiring no additional wiring or control power and be self-protected from short circuits in the motor branch circuit. Melting alloy type overload relays are not acceptable. Each overload shall be adjustable over a full 2:1 full load amp (FLA) adjustment range. The overload must have a + or - 2% trip repeatability over its entire operating range. A tamper proof cover must be provided to discourage the unauthorized adjustment of the overload. The standard overload shall provide NEMA class 20 overload protection, but class 10 and class 30 protection must also be available. The overload must provide phase loss protection by tripping in 3 seconds or less under a phase loss condition. The overload must be capable of protecting the motor in a starting, full load, or lightly loaded condition against single phase damage. The overload and phase loss protection must not be able to be defeated by any changes to the setting of the overload. The overload must be ambient insensitive and able to operate in a temperature range of -22°F to +159°F. The overload relay must have a trip free normally closed contact rated NEMA A600 with a visible trip indication. Optional N.O. or N.C. isolated alarm contacts must be available for the overload relay. The overload must have a method of being manually tripped for test purposes.

Combination motor starters shall be as specified above but shall also contain a heavy duty, load break, knife type disconnect switch. Switch shall be either fused or unfused as shown on the project drawings. If not shown on the project drawings, furnish a fused switch. Starter, switch and fusing shall be contained in a common enclosure.

A brand name motor starter known to meet the salient characteristics of this specification is Furnas model ESP100, class 14 for full voltage non-reversing starters and class 17 for combination starters. Type of starter shall be as shown on the project drawings.

2-9.5 Safety Switches: Safety switches shall be NEMA rated as heavy duty. Enclosures shall be NEMA type 1 in indoor locations and NEMA type 3R in outdoor or damp locations unless shown on the project drawings to be a different type for the specific application. Switches shall be of the number of poles, voltage and amperage ratings shown on the project drawings. Furnish fuse clips to receive cartridge type dual element fuses in all poles if fusible switches are required on the project drawings. Switches shall be the quick-make, quick-break type with visible blades. Switch handles shall be the extended arm type for easy identification of position. Switches which utilize rocker arm type handles or have concealed blades are not acceptable. Switch handles shall be capable of being secured in both the on and off positions by use of a Government owned and installed padlock with a 5/16" diameter shackle. The switch cover shall also be capable of being secured in the closed position with a separate Government owned and installed padlock with a 5/16" diameter shackle. The Contractor shall modify the switch as required to achieve these locking capabilities. The switch shall be grounded with a separate lug secured to the enclosure's bare metal with a bolt and nut. The use of the switches' neutral bus with, or without, a grounding electrode screw bonding to the enclosure is not a satisfactory enclosure ground. A brand name safety switch known to meet the salient characteristics of this specification is Square D, Class 3110, Heavy Duty.

2-9.6 Power Panels: Panel covers shall be hinged to the panel enclosure on the left side to permit access to the panel interior without the need to lift or remove the cover. The panel door shall be hinged to the panel cover as is standard with all manufacturers.

2-10.0 FIRE PROTECTION: All indoor insulating and acoustical materials, vapor barrier, covering and wrapping materials permanently attached or installed separately shall not exceed flame spread 25 and smoke developed 50, as rated by Underwriter's Laboratories.

All conduits and pipes which penetrate floors (except ground floor) of multistory buildings and which penetrate fire barrier walls as designated in the Uniform Mechanical Code shall have the excess void or cavity sealed with firestop compound. Compound shall be Underwriters Laboratories, Inc. listed for use in through-penetration firestop system. Firestop shall be "Flamesafe" Cat. No. FS 900 as manufactured by International Protective Coatings, Inc., or approved equal.

2-11.0 DEMOLITION: Any existing furniture, cabinets, equipment racks or other items which obstruct the Contractor's access to the work area shall either be temporarily relocated by the Contractor to a storage area designated by the R.E. or be covered in a manner as to provide suitable access while protecting the Government property from construction damage. At the completion of all work, the Contractor shall return all such items to their original location.

Any unused conduit, wire, duct, pipe, structural supports or other fittings associated with equipment or devices to be removed under this contract shall also be removed.

All conduit shall be totally removed unless approved by the R.E to only remove it back to the first existing junction box or electrical fitting. Remove all unused wire back to the source power panel. Any circuit which must continue to operate shall be rewired for continuity. Seal all unused conduit with electrical plugs.

All refrigerant which is either a "CFC" or an "HCFC", as classified by the Environmental Protection Agency (EPA), must be recovered, decontaminated and recycled in accordance with "The National Recycling And Emissions Reduction Program" of the EPA. Intentional venting of covered refrigerant gasses is subject to criminal penalties.

Remove unused structural support angles, channels, bolts, and similar hardware. Patch any holes resulting from removed equipment, hardware, conduit or pipe with the same material as that of the penetrated surface (ie: concrete floor openings shall be filled with concrete). Paint patch to match adjacent undisturbed surface.

After removal of floor supported equipment, clean and/or replace any floor finish or covering to match adjacent undisturbed floor covering. Acoustical ceiling tiles or T-bar grid members which have holes resulting from removed duct or diffusers shall be removed and replaced with new components of equal quality and appearance to the adjacent undamaged ceiling.

Any equipment or material to be removed, unless shown to be given to the R.E., shall become the property of the Contractor and shall be transported from the site and disposed in a legal manner.

2-12.0 FINISHES: All exposed interior and exterior ductwork, piping, support structures, conduit, and electrical fittings installed under this contract shall be painted to a color selected by the R.E. Painting of indoor items shall consist of one coat of latex primer and one coat of exterior latex semi-gloss enamel. (Latex shall be used indoors to minimize odor.) Painting of outdoor items shall consist of one coat of oil based primer and one coat of exterior oil based semi-gloss enamel. Paint galvanized surfaces with one coat of "Speedhide Interior/Exterior Galvanized Steel Primer", No. 6-209 white, as manufactured by Pittsburgh Paint Company. Paints shall be certified by their manufacturer for use on the intended surface materials and shall be applied in accordance with his instructions. Latex paint shall be "Acry-Sheen" acrylic semi-gloss as manufactured by Evr-Gard Coatings, Paramount, CA, or approved equal. Oil based

paint shall be specifically formulated for corrosion resistance and shall be high performance industrial enamel as manufactured by "Rust-Oleum", or equal.

2-13.0 IDENTIFICATION: The air conditioning equipment shall be identified to show designator. Identify safety switches, power panels, cabinets, etc. to show equipment served, voltage, phase, and fuse amperage rating. Identify control panel and all controls to show function.

Identification shall be by plastic engraved nameplates with white letters and black background. Letter size shall be 1/8" for controls, 3/16" for devices on control panel covers and 3/8" for safety switches, air conditioning equipment and other equipment devices. Nameplates shall be secured to equipment, cabinets and to controls with adhesive backing. In addition, nameplates installed outdoors shall be secured with two screws.

Identify all new and modified pipes to show contents (i.e.: Refrigerant Suction, etc.) and flow direction. Identification shall be with color coded, printed plastic bands secured around the entire circumference of pipe insulation. Bands shall be "Setmark" as manufactured by Seton Nameplate Corp., or approved equal. Install bands on maximum 10 foot intervals and at each change of pipe direction.

2-14.0 CLEANING: Ducts, plenums, and casings shall be thoroughly cleaned of all debris and blown free of all small particles of rubbish and dust before installing outlet faces. Equipment shall be wiped clean, with all traces of oil, dust, dirt or paint spots removed.

The contractor shall be responsible for repairs to any construction damage to government owned property.

2-15.0 AIR BALANCING AND DOCUMENTATION: (Prior to startup of each air conditioning unit, air handling unit, and fan coil unit, verify that all nuts and bolts securing the motors and fans on each unit are tight and secure.) Each air conditioning unit, air handling unit and fan-coil unit system shall be air balanced on both the 100% return air and the 100% supply air. The Contractor shall be responsible for furnishing, installing and adjusting blower drive sheaves to achieve specified airflow rates on both new and existing air handling equipment. Setting of dampers and other volume adjustment devices shall be permanently marked so they can be restored if disturbed at any time. All air measurement readings taken during the adjustment work shall be recorded and two (2) copies of resulting data shall be furnished to the Resident Engineer for approval.

Furnish a legible handwritten or typewritten report documenting air balance test data which shall include the following:

- 1) System Number

- 2) Area Served
- 3) Date of Test
- 4) Name of Individual Certifying Test
- 5) Design Air Quantities (CFM) - (show at each air handling unit's supply, return and outside duct connections)
- 6) Actual Air Quantities (CFM) - (Same as 5)
- 7) Actual Air S.P. (inches W.G.) - (Show pressure relative to atmosphere at blower inlet and outlet, at upstream and downstream side of filters, at upstream and downstream side of cooling and/or heating coils, and at return air duct connection and at supply air duct connection of air conditioning unit or air handling unit cabinet.)
- 8) Air Temperature Entering Cooling/Heating Apparatus
- 9) Air Temperature Leaving Cooling/Heating Apparatus
- 10) Indoor Motor H.P. (Nameplate)
- 11) Indoor Motor Amps (Nameplate)
- 12) Indoor Motor Amps (Measured)
- 13) Indoor Motor Volts (Nameplate)
- 14) Indoor Motor Volts (Measured)
- 15) Indoor Motor RPM (Nameplate)
- 16) Indoor Fan RPM (Measured)

2-16.0 REFRIGERATION STARTUP REPORT: After completion of the installation or modification of any refrigeration system, the following information shall be recorded and submitted to the R.E. for approval.

Furnish a legible handwritten or typewritten report documenting refrigeration system test data which shall include the following:

- 1) System Number
- 2) Area Served

- 3) Date of Test
- 4) Name of Individual Certifying Test
- 5) Outdoor Air Temperature
- 6) Evaporator Entering Air Temperature
- 7) Type of Refrigerant

Show items 8 thru 21 for each refrigerant circuit:

- 8) Test Pressure and Ambient Temperature During Medium Pressure Leak Testing
- 9) Weight of Refrigerant in Each Circuit
- 10) Refrigerant Suction Pressure
- 11) Saturated Suction Temperature (show from chart)
- 12) Superheated Suction Temperature
- 13) Superheat (calculated value)
- 14) Refrigerant Condensing Pressure
- 15) Saturated Condensing Temperature (show from chart)
- 16) Subcooled Liquid Temperature
- 17) Subcooling (calculated value)
- 18) Motor Amps (Nameplate) (Show for all compressors)
- 19) Motor Amps (Measured) "
- 20) Motor Volts (Nameplate) "
- 21) Motor Volts (Measured) "
- 22) A/C Unit Amps (Nameplate) (Show total for unit with all compressors running)
- 23) A/C Unit Amps (Measured) "

- | | | |
|-----|----------------------------|---|
| 24) | A/C Unit Volts (Nameplate) | " |
| 25) | A/C Unit Volts (Measured) | " |

2-17.0 INSTRUCTION MANUALS: Upon completion of work, the Contractor shall submit to the RE two (2) bound copies of an instruction manual. This manual shall contain, but not be limited to, instructions for installation, operation and maintenance, replacement parts list, sequence of operation description, sizing and capacity data and manufacturer's guarantee information for all equipment furnished by the Contractor.

2-18.0 SPARE PARTS: Furnish one spare set consisting of the quantity and type of each power and control fuse used in each safety switch, air conditioning unit, control panel or other electrical device furnished under this contract. One set shall be placed in the enclosure of each of these devices. Furnish 5 additional sets of air filters for each system installed or modified.
